# APPENDIX C - ASSUMPTIONS FOR FIRE REGIME CONDITION CLASS CALCULATIONS

## METHODOLOGY FOR CALCULATING FIRE REGIME CONDITION CLASS AND CONDUCTING ALTERNATIVE COMPARISON

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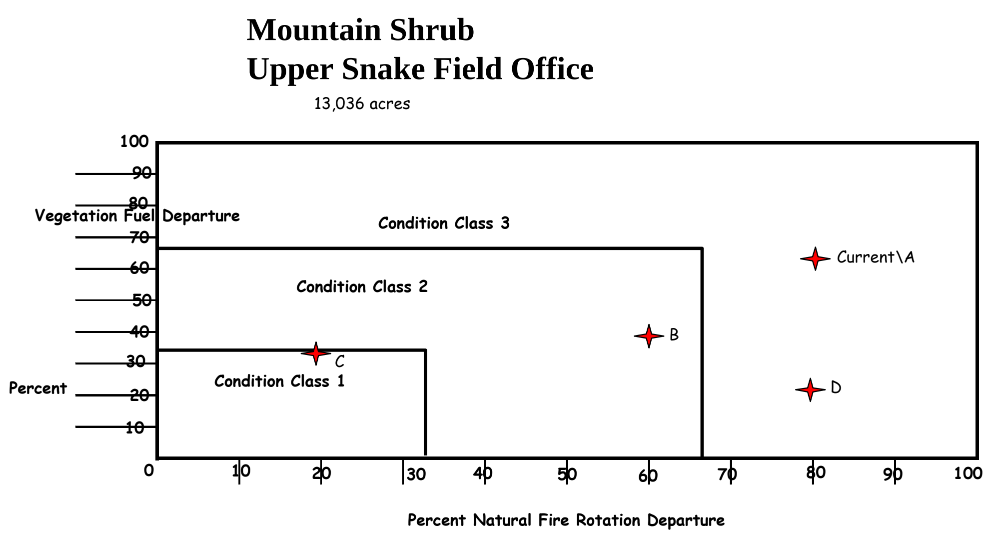
## C.1 INTRODUCTION

Displayed long-term effects of each alternative are based on the estimated differences or *departure* from desired vegetation/fuels conditions (i.e., proportions of age-classes/successional stages and/or uncharacteristic vegetation across the landscape) **and** departure from the natural fire rotation (NFR) or Fire Regime Condition Class (FRCC). NFR is defined as the historic average number of years required in nature to burn over and reproduce an area equal to the total area under consideration (Heinselman 1973). Long-term effects were represented as an FRCC rating and were calculated for each vegetation cover type by field office over a 30-year period. The departures discussed above represent the overall FRCC rating for a given vegetation cover type and were graphed for each alternative and compared. FRCC was a primary evaluation measure used in the vegetation and wildlife effects analysis. Below is an example of the resulting FRCC graph produced for the mountain shrub vegetation cover type in the Upper Snake Field Office area. The vegetation/fuels departure is displayed on the y-axis and the NFR departure is displayed on the x-axis, and shows where each alternative falls within the FRCC graph.



This analysis was based on the concepts presented in the national interagency project scale FRCC Methods Guide with modifications. Modifications included using the NFR concept for the fire regime analysis (x-axis on the graph above). Fire Return Intervals (FRIs) reported in the scientific literature were converted to a natural/historic fire rotation for each vegetation cover type. Modifications were possible and were considered an improvement over the FRCC Guide protocol because, for current fire rotation, 32 years of large wildland fire perimeter data were available for the planning area and used to calculate current fire rotation departure from historic fire rotation. Modifications were made because quantitative field data on fire frequency and severity were not available across all vegetation cover types across the planning area as suggested in the FRCC guidebook.

The second modification included developing an equation that uses NFR and the longevity of successional stages to determine historic/reference vegetation conditions. The FRCC guidebook suggests using Potential Natural Vegetation Group (PNVG) or Biophysical Setting (BpS) for historical/reference conditions. At the time of this analysis, only national, broad-scale PNVGs were available for FRCC calculations. These PNVGs were reviewed for use in FMDA but were not used because they did not accurately reflect the local biophysical conditions.

Additionally, successional pathway diagrams were developed to determine future vegetation conditions and were used to compare to historic/reference vegetation conditions. The interagency methodology does not provide a method for *futuring* or comparing alternatives and predicted FRCC results given differing treatment levels. The successional pathway diagrams incorporated fire history data and past restoration/rehabilitation actions and were used to estimate the vegetation/fuels departure (y-axis on the graph above) from a Reference Condition/Desired Future Condition (DFC) for each alternative. Successional pathway diagrams allowed the team to analyze the effects of differing broad levels of treatment and priorities (Alternatives A through E on vegetation structure and composition over the long run (30 years into the future).

The following data were used in the vegetation and FRCC analysis:

- Average annual burned acres calculated from actual 1972-2002 wildfire occurrence (in a digital geographic information systems [GIS] format).
- Literature and studies that reference historic FRIs for cover types.
- Average annual treatment acres calculated from actual 1995–2000 treatment acres.
- Estimated annual treatment acres by alternative calculated from resource specialist estimates for 2003–2013.
- Estimated acres of areas with cheatgrass (*Bromus tectorum*) present as provided by resource specialists.
- Estimated acres of areas with introduced grasses present based on past rehabilitation efforts.
- Estimated acres of areas with juniper encroachment provided by resource specialists.

# C.2 CALCULATING CURRENT FRCC

## C.2.1 VEGETATION/FUELS DEPARTURE CALCULATIONS (Y-AXIS)

This section describes how Reference Conditions/DFC and current vegetation/fuel conditions were estimated and used in the FMDA analysis. Additionally, it describes how successional pathway diagrams were used to compare the effects of the alternatives using 10 years of treatment levels proposed over 30 years.

### *Reference Conditions/Desired Future Condition (Vegetation/Fuels)*

Reference conditions were used in the vegetation/fuel departure calculation (Y-axis). Reference conditions developed for FMDA are synonymous with DFC. DFC is a management objective that is expected to produce a distribution of vegetation age classes across the landscape, which will alter fuels/vegetation structure, promote a healthier and more diverse vegetation composition, and return the currently altered fire regimes to fire regimes that more closely parallel historical fire regimes. DFC includes uncharacteristic vegetation that was incorporated as recommended by the IDT because, in all likelihood, uncharacteristic vegetation will remain a part of the future vegetation mosaic in the planning area. DFC varies by vegetation type and is a common objective among Alternatives B, C, D, and E. Management goals and DFC for the planning area's vegetation cover types is presented in Chapter 4, Section 4.2.

DFC was determined using the NFR, a correction for uncharacteristic vegetation, and the longevity of successional stages as described below:

- NFR. The FRI reported in the scientific literature was converted to an NFR for each vegetation cover type. The mid-point of the range of years derived from the scientific literature and/or from expert opinion was used in the NFR calculation. For the example of low-elevation shrub, estimates of FRI range from 60 years to 110 years between wildland fires. The mid-point of 85 years/wildland fire was used in the calculation of NFR for this vegetation cover type. NFR was calculated using the FRI mid-point value for each vegetation type on average. To determine an average annual percentage burned per year, the total area (100 percent) was divided by the mid-point FRI (85 years) which produced the resulting NFR of 1.18 percent burned per year. This calculation assumes that each acre has an equal chance of burning.
- Correction for Uncharacteristic vegetation in DFC: DFC includes uncharacteristic vegetation, which was incorporated as recommended by the IDT because, in all likelihood, uncharacteristic vegetation will remain a part of the future vegetation mosaic in the planning area. Percentages of uncharacteristic vegetation within each vegetation cover type were estimated. In the example of low-elevation shrub-early successional stage DFC, up to 15 percent of total vegetation cover is expected to remain dominated by cheatgrass/weeds and 5 percent would remain dominated by crested wheatgrass. When added together (20 percent) and subtracted from the whole, this indicates that 80 percent (0.8) of low-elevation shrub-early successional stage would consist of characteristic or native species.
- Successional Stages: The longevity of each age class (successional stage) for each vegetation cover type was estimated. In the example of low-elevation shrub-early

successional stage DFC calculation, it was estimated that early successional acres would move to mid-successional acres after 15 years, so 15 years was used in the DFC calculation. A DFC was calculated for each vegetation type, for each successional stage.

An example of the formula used to calculate DFC for low-elevation shrub-early successional stage is provided below:

**DFC = (NFR) x (CV) x (SS)**

Where:

NFR = ***Natural Fire Rotation***-Calculated for the entire vegetation cover type.

CV = ***Characteristic Vegetation***- The percentage of characteristic vegetation within the vegetation cover type

SS = ***Successional Stage***- The longevity of a successional stage for a given vegetation cover type in years.

For Example, Low-Elevation Shrub, Early Successional Stage DFC

NFR = 1.18% or 0.0118

CV = 80% or 0.8 (i.e., 20 percent of this vegetation cover type is currently in an uncharacteristic state and was not part of the historical mix of age-classes/successional stages)

SS = 15 years

**DFC = (0.0118) x (0.8) x (15) = (0.14) or 14 percent**

The DFC chosen for each vegetation cover type reflects the overall mixture of succession stages expected over time across a field office given a rate (or range of rates) of disturbance similar to that of historical times (pre-European settlement). The underlying assumption being that, through time, plants and animals have evolved and adapted to a similar rate of disturbance and should therefore be more resilient and less likely to be at risk of loss of key ecosystem components in the face of large and/or severe disturbance.

### *Calculating Current Successional Stage Acreage Percentages*

Current age class/successional stage acreage percentages were derived using the 32-year fire history and past treatment data for each vegetation cover type by field office. These were compared to the DFC acreage percentages identified for that vegetation cover type. The dissimilarity rating between the current successional stage percentages and the DFC percentages represents the current FRCC vegetation/fuels departure, the Y-axis value for current.

## C.2.2 Fire Rotation Departure Calculations (X-axis)

NFR is defined as the average number of years required in nature to burn over an area equal to the total area under consideration (Heinselman 1973), as discussed previously. NFR represents the historic (pre-European man) fire rotation for each vegetation cover type and also defines desired fire rotation to which current fire rotations are compared. An equation was used to arrive at fire rotation as follows:

$$\frac{\textbf{(Total Time Period)}}{\textbf{(Area Burned and Treated in Time Period ÷ total veg a}} = \textbf{Fire Rotation}$$

where:

***Total Time Period (FMDA) =***

***Natural fire rotation*** = Fire Return Interval (FRI) Mid-Point
or
***Current fire rotation*** = 1972-2002 years fire history (32 years)

***Area Burned and Treated in Time Period (FMDA) =***

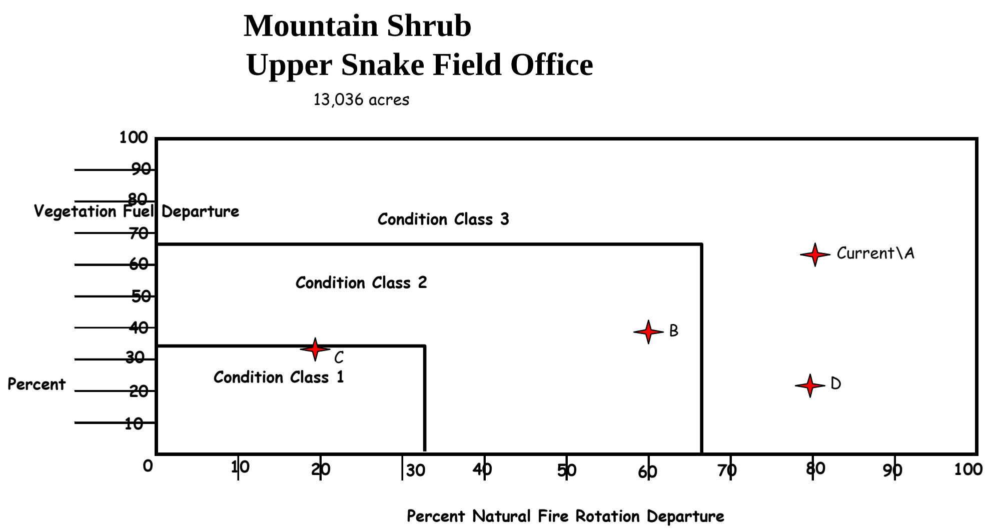
***Natural*** = see Y-AXIS explanation above for NFR
or
***Current*** = Wildfire acres burned + treatment acres 1972-2002

More specifically, a literature search was conducted and an NFR was calculated for each cover type as referenced in pertinent literature for the cover types (See Chapter 3, Section 3.2 for estimated historic fire rotation by vegetation cover type).

To calculate current fire rotation, departure was determined by first estimating the current fire rotation using the total acres within a vegetation cover type and the acres burned in that vegetation cover type during the period of 1972-2002. Second, the desired fire rotation was determined with the assumption that the desired rotation should be approximately equal to the historic rotation.

## C.3 PREDICTING FUTURE FRCC TO COMPARE ALTERNATIVES

Displayed long-term effects of each alternative are based on the estimated differences or *departure* from desired vegetation/fuels conditions (i.e., proportions of age-class and/or uncharacteristic vegetation across the landscape) **and** departure from the NFR or FRCC. Long-term effects were represented as an FRCC rating and were calculated for each vegetation cover type by field office over a 30-year period. The departures discussed above were graphed for each alternative and compared. FRCC was a primary evaluation measure used in the vegetation and wildlife effects analysis. Below is an example of the resulting FRCC graph produced for the mountain shrub vegetation cover type in the Upper Snake Field Office area. The vegetation/fuels departure is displayed on the y-axis and the NFR departure is displayed on the x-axis, and shows where each alternative falls within the FRCC graph.



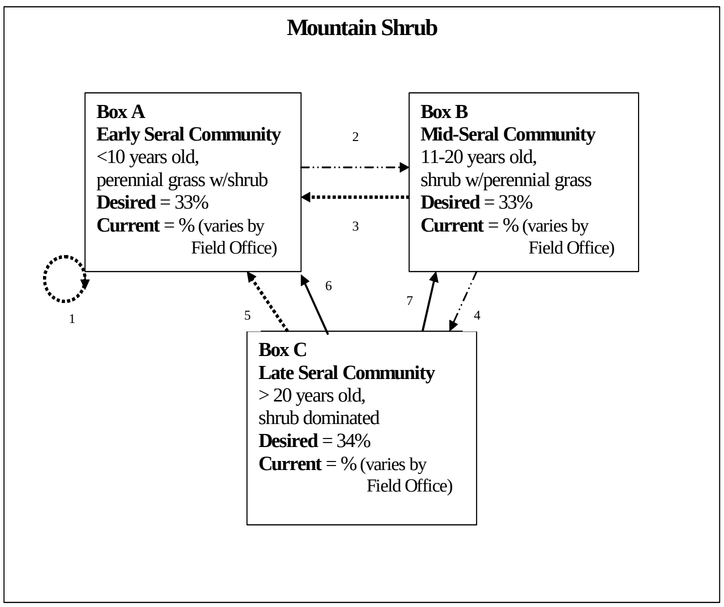

### C.3.1 PREDICTING FUTURE VEGETATION/FUEL DEPARTURE

Successional pathway diagrams were developed to determine future vegetation conditions and used to compare to historic/reference vegetation conditions. The successional pathway diagrams incorporated fire history data and past restoration/rehabilitation actions and were used to estimate the vegetation/fuels departure (y-axis on the graph above) from a Reference Condition/DFC for each alternative. Successional pathway diagrams allowed the team to analyze the effects of differing broad levels of treatment and priorities (Alternatives A through E on vegetation structure and composition over the long run (30 years into the future).

To analyze the effects of each alternative, acres of treatment proposed, successional timeframes specific to each vegetation cover type, and expected levels of wildland fire (in this order) were processed through the successional pathway diagrams using specific assumptions developed for each vegetation cover type. For our purposes, mechanical treatments were treated as a disturbance similar to wildland fire (in its effect on succession). The suite of restoration and rehabilitation treatments used in low-elevation shrub (Rxfire, chemical, and seeding) were assumed to make this vegetation cover type more resilient to wildland fire – eventually reducing the number of acres burned over the long-term. The end result of the successional pathway diagram runs (proportion of acreage within each successional community [or box] after 30 years time) were compared to DFC percentages. The dissimilarity rating between an alternative's successional community acreage percentages and the DFC acreage percentages represents the FRCC vegetation/fuels departure for that alternative across vegetation cover types (see the national interagency project scale FRCC Methods Guide for additional details on calculating dissimilarity ratings).

Predicted successional stage percentages were estimated within each box (successional community) for each alternative, for each vegetation type, and were derived using the treatment levels proposed in each alternative, as well as assumptions regarding wildland fire occurrence using 32-years of fire history data (for each vegetation cover type by field office). These were compared to the DFC acreage percentages identified for that vegetation cover type. The dissimilarity rating between the current successional community percentages and the DFC percentages represents the current FRCC vegetation/fuels departure (i.e., current Y-axis departure).

Reference and current condition percentages were used to analyze predicted changes in vegetation/fuel conditions (Y-AXIS) using successional pathway diagrams. For each field office, numerous successional pathway diagrams were developed - one per vegetation cover type or, in some cases, groups of vegetation cover types that succeed toward a potential natural vegetation community (e.g., aspen/conifer mix and dry conifer). These diagrams were used to model changes in vegetation structure that would occur given an alternative treatment level over the next 10 years, predicted amount of wildland fire, and successional rates inherent to a vegetation cover type. Below is an example of the successional pathway diagram developed for the mountain shrub vegetation cover type.




The successional pathway diagram analysis was completed separately for each field office area. All successional pathway diagrams and assumptions used in the analysis are available in the FMDA administrative record.

### *Assumptions*

Assumptions used in conjunction with the mountain shrub successional pathway diagram include:

solid arrow = restoration treatments (for some vegetation cover types this would include rehabilitation treatments as well)
broken arrow = succession
dashed arrow = wildland fire

**Restoration**

Arrows #6, #7 **–** 100 percent of total restoration acres occur in Box C; 70 percent of these acres move from Box C to Box A, the other 30 percent moves from Box C to Box B.

**Succession**

Arrows #2, #4 **–** In 30 years, 80 percent of acres in Box A moves to Box B due to succession. In 30, years 50 percent of acres in Box B moves to Box C due to succession.

**Wildland Fire**

Arrows #1, #3, #5 **–** Wildland fire acres occur in the same proportions as the mountain shrub successional community distribution for a field office (i.e., if 70 percent of the mountain shrub vegetation cover type is in a late seral stage [Box C], then 70 percent of the total wildland fire acres were assumed to occur in Box C).

### C.3.2 Predicting Future Fire Rotation Departure

NFR represents the historic (pre-European man) fire rotation for each vegetation cover type and also defines desired fire rotation to which predicted future fire rotations are compared. An equation was used to arrive at fire rotation as follows:

$$\frac{\textbf{(Total Time Period)}}{\textbf{(Area Burned and Treated in Time Period} \div \textbf{total veg a}}\ \textbf{= Fire Rotation}$$

where:

***Total Time Period (FMDA) =***

***Natural fire rotation*** = Fire Return Interval (FRI) Mid-Point
or
***Current fire rotation*** = 1972-2002 years fire history (32 years)
or
***Predicted future fire rotation*** = 2002-2030 (30 years into the future)

***Area Burned and Treated in Time Period (FMDA) =***

***Natural*** = see Y-AXIS explanation above for NFR
or
***Current*** = Wildfire acres burned + treatment acres 1972-2002
or
***Predicted Future*** = Predicted wildfire acres + wildfire reduction ratio** + alternative treatment levels 2002-2030

** **Wildland Fire Reduction (WFR) Ratios** were developed for vegetation cover types where more acres have burned than the historic fire rotation would have allowed over the last 32 years (i.e., low-elevation shrub and annual and perennial grass). Because it was assumed that treatments would reduce the potential for wildfire, wildfire acres were reduced to account for treatment effectiveness in the future.

To calculate predicted future fire rotation, each alternative's fire rotation by vegetation cover type was determined by running levels of treatment and estimated wildland fire acres (assumed to be at a level similar to the previous 30 years for all vegetation cover types except low-elevation shrub and annual and perennial grass where the WFR ratio was applied – see below) through the fire rotation equation. The current and alternative fire rotations by vegetation cover type were compared to the historical/desired fire rotations. The dissimilarity rating between an alternative's fire rotation and the desired fire rotation for given vegetation cover type represents the FRCC NFR departure (see the national interagency project scale FRCC Methods Guide for additional details on calculating dissimilarity ratings).

## C.4 MONITORING FOR FRCC IN THE FUTURE

Refining FRCC methods to the project scale (mid-scale FRCC):

- Use the FRCC methodology described above (see bullets below for additional guidance as well as the national interagency project scale FRCC Methods Guide - http://www.frcc.gov as of May 3, 2004).
- Complete FRCC calculations prior to setting objectives and implementing treatments within units of a planning area. FRCC calculations should be recalculated on a five-year rotation in preparation for planning area-wide data calls. Fire Use Specialists for each field office could complete project-scale FRCC calculations with the assistance of fire GIS personnel.
- Convert fire atlas and past fuels/range/forestry/wildlife treatment boundaries within the planning area to a digital spatial format (GIS coverage)
- GPS all wildland fire, fuels treatment, or other restoration treatment perimeters (include in the mapping of large islands of unburned/untreated vegetation if possible) over the life of the project (LOP). Amend digital fire/treatment atlas at the end of each calendar year.

**Y-AXIS (Vegetation/Fuels Departure)**

- For the planning area, determine *current* proportions of age-classes/successional stages by vegetation cover type (i.e., potential natural community) (successional classes = early, middle, late, uncharacteristic) – It is suggested that digital wildfire/treatment GIS coverage in conjunction with FMDA assumptions (concerning the number of years it generally takes a vegetation cover type to move from an early to middle age-class/successional stage and from a middle to late age-class/successional stage - i.e., the break points between stages) be used AND any digital spatial data on uncharacteristic vegetation, including noxious or exotic weed infestation areas, juniper encroachment areas, etc. Refine age-class/successional stage and uncharacteristic vegetation proportion estimates using field inventories if possible.
- For similarity calculations between current and DFC, use DFC age-class percentages by vegetation cover type identified in FMDA as a starting point – adjust if necessary to take into consideration the planning area concerns/information provided by staff specialists, interested publics, etc.

**X-AXIS (NFR Departure)**

- For the planning area, determine current fire rotation by vegetation cover type using the digital wildfire/treatment GIS coverage.
- For similarity calculations between current and DFC, use the NFR mid-points (by vegetation cover type) as identified in FMDA for the *desired* fire rotation.

**Roll up FRCC data from all planning areas within planning area:**

- Make planning area-wide data calls on a five-year rotation.
- Summarize data into number of FRCC 1, 2, and 3 acres by vegetation cover type within the planning area as a whole.
- Complete the planning area-wide FRCC data roll-up by the District Fire Ecologist or the District Fire Use Specialist with the assistance of fire GIS personnel.